

## Faculty of Science and Engineering

### Profile report: Engineering Autonomous Systems

- Discipline: Computer Science; Artificial Intelligence; Autonomous Systems
- Level: Tenure-track assistant professor
- Fte: 0,8-1,0 fte

#### 1. Scientific discipline

The discipline of autonomous systems encompasses foundational, engineering, and technological aspects supporting the development and management of software-intensive systems characterised by autonomy and self-adaptation. It focuses on system design, system and software architectures, and enabling technologies.

#### 2. Vacancy

This position is opened by the Board of the Faculty (*mail JP Timmerman dd. 24-01-23, subject: Besluit FB tav EngD en UD's met onderwijsprofiel*) and will be embedded in the Bernoulli Institute, base unit Software Engineering. The position falls within the framework of the faculty's career system [Career Paths in Science and Engineering](#). The position falls within the framework of the faculty's career system Career Paths in Science and Engineering. As the focus domain of the position is education, the criteria of the career path with a focus on education apply. Please see the link for more information.

#### 3. Selection committee (BAC)

- Prof. dr. P. Avgeriou, Professor Software Engineering, Scientific director of the EngD in Autonomous Systems, Bernoulli Institute;
- Prof. dr. B. Jayawardhana, Professor Mechatronics and Control of Nonlinear Systems, Scientific director, ENTEG;
- Prof. dr. N. Taatgen, Professor Cognitive Computing, Scientific director, Bernoulli (chair);
- Prof. dr. D. Karastoyanova, Professor Information Systems, Bernoulli Institute;
- Prof. dr. R. Carloni, Professor Robotics, Bernoulli Institute
- Prof. dr. B. Besselink, Professor Systems and Control, Bernoulli Institute
- Prof. dr. R. Mirandola, Professor Software Engineering and Self-Adaptive Systems, Karlsruhe Institute of Technology (KIT), Germany.
- Student member (tba)

#### Advisors:

- Prof. dr. A. Lazovik, Educational director, Bernoulli Institute;
- M. Laning (HR advisor Bernoulli Institute)

#### **4. Area of expertise**

The expertise area of autonomous systems combines foundational aspects (e.g. control theory, self-adaptation), engineering (e.g. model-driven engineering, run-time reconfiguration), and technological aspects (e.g. Machine Learning, Computer Vision, Sensor Technologies, Robotics, Cloud computing, Human-Machine Interface) to support the development of software-intensive systems characterised by autonomy and self-adaptation. Such systems often operate 24/7, and are characterised by complexity, a long service life as well as uncertain operational conditions. Examples of such systems include autonomous cars/vehicles, Internet of Things, autonomous robots, Systems of Systems, smart manufacturing systems, etc.

Autonomous Systems evolves from the advancement of software/systems engineering, robotics, artificial intelligence, systems & control and mechatronics. The field has attracted significant interests for improving the current production process, improving the performance of high-tech systems, as well as providing new innovative solutions such as autonomous vehicles, autonomous robots and autonomous machines.

The position will develop a new Engineering Doctorate (EngD) programme on Autonomous Systems and supervise Engineering Doctorate students that work closely with high-tech industries and conduct teaching and research in the aforementioned fields. The Autonomous Systems EngD programme is a strategic programme of the university as part of education innovation and a bridge between fundamental research activities at the University of Groningen and industrial R&D programmes at high-tech companies in Netherlands. It is part of the Dutch Sectorplan in Techniek II. The EngD programme is jointly run by Engineering and Technology Institute Groningen (ENTEG) and Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence.

#### **5. Embedding: institute (and base unit)**

The Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence is part of the Faculty of Science and Engineering (FSE). The profile of the institute centres around modelling, computation, cognition and software infrastructures with a focus on science and technology, keeping a balanced mix of fundamental and applied aspects.

The Bernoulli Institute comprises five mathematics programmes, seven computer science programmes, and four artificial intelligence programmes, which participate in various national research schools. The Bernoulli Institute has a leading role in the cross-disciplinary research theme Data Science and Systems Complexity (DSSC), and in the Groningen Cognitive Systems and Materials Center (CogniGron) within the Faculty of Science and Engineering.

The candidate is expected to contribute to the existing research activities within the Software Engineering group. The Software Engineering group covers the broader discipline of Software Engineering: Software requirements, Software design, Software construction, Software testing, Software maintenance, Software configuration management, Software engineering management, Software engineering process, Software engineering models and methods and Software quality. Emphasis on empirical

research methods as well as social/human aspects, AI for Software Engineering, software analytics, and automation tools will also be considered. The group comprises currently of 2 full professors, 2 associate professors and 2 tenure-track assistant professors.

## **6. Local and (inter)national position**

The position is expected to strengthen the design methods and tools for the development of high-tech software-intensive systems (such as mechatronics, smart manufacturing systems, healthcare systems, Internet of Things and robotics systems) in Groningen. It is foreseen that the new position will have unique possibilities of local synergies with the Distributed Systems group of prof.dr. Alexander Lazovik, the Information Systems group of prof.dr. Dimka Karastoyanova (Bernoulli), the Mechatronics group of prof. dr. Bayu Jayawardhana (ENTEG), the Autonomous and Perceptive Systems group of prof. dr. Lambert Schomaker (Bernoulli) and the Robotics groups of prof. dr. Ming Cao (ENTEG) and prof. dr. Rafaella Carloni (Bernoulli). In this sense, the position will also strengthen the collaboration between the two institutes involved in the EngD Programme: ENTEG and Bernoulli.

In the Netherlands, there are two other EngD programmes that are related to the foreseen EngD programme in Autonomous Systems in RUG (aimed to start in September 2024). These are the Mechatronics Systems Design EngD programme at Eindhoven University of Technology and the Robotics EngD programme at University of Twente. The focus of EngD programme in Groningen will be on the integration of enabling technologies for autonomous systems (such as AI methods, sensor technology, robotics) with the classical model-based engineering techniques. This focus is not offered elsewhere in the Netherlands.

The northern region of the Netherlands (Groningen, Friesland, Drenthe), has received an EU label for the European Digital Innovation Hub in Autonomous Systems, and it has led the national activities on Smart Industry. In the world, the field of autonomous systems has grown rapidly, following the same trend as above and is part of national programmes in a number of industrialized countries, including United States, European Union, China, South Korea and Japan.

## **7. Expected contributions to teaching**

The candidate will be appointed at the level of Assistant Professor and they will contribute 60% of their time to education. More specifically, the candidate is expected to take a leading role in the innovation of education for the Engineering Doctorate programme in Autonomous Systems, with a particular focus on Computer Science and Software Engineering. The candidate will coordinate various courses, such as the following post-master courses:

- Foundations of self-adaptive systems
- Modelling and architectures for autonomous systems
- Enabling technologies for autonomous systems

- Trustworthiness (dependability, safety and security) for autonomous systems

The candidate will co-develop the teaching materials together with teaching staff at the Bernoulli Institute and ENTEG, and align them with the industrial partners, to ensure that the state-of-the-art course materials will be relevant for industry. The candidate will supervise EngD projects and lead the development of laboratory equipment for the EngD programme.

## **8. Expected contributions to research**

At the level of Assistant Professor, the candidate will contribute 30% of their time to conduct research activities that align with the ongoing activities in the Software Engineering unit. This embedding ensures that their teaching activities are strongly related to the state-of-the-art research in the field, conducted within the unit. Within Software Engineering, research focuses on Empirical Software Engineering, Cloud-based Systems, Developer Tools, Systems of Systems, Domain-Specific Languages, AI for Software Engineering, Human Factors, Maintenance and Evolution, Mining Software Repositories, Software Architecture, Sustainable Software and Technical Debt. Depending on the background of the candidate, they can contribute to a subset of research areas mentioned above. The candidate is expected to contribute to the supervision of PhD students.

The candidate is expected to contribute to securing industrial funding to support EngD projects that can be linked to research projects in the unit. The source of funding can be regional, national via NWO or international via the EU.

## **9. Expected contributions to the organization**

The candidate is expected to have an active interest and to provide a positive contribution to the management and organisational tasks of the institute. At the level of FSE, the candidate will contribute to the organisation of the faculty, for example by participating in working groups and committees in the area of education and preferably with a specific focus on issues related to the EngD programme. The candidate will participate in relevant national and international organisations.